ZOOLOGY.

THE CAUSE OF THE PARASITIC HABIT IN CERTAIN BIRDS.

A THESIS by Robert Fulton, M.B.

The study of the habits of the Birds of New Zealand, at all times a fascinating one, is rendered more so, by the fact that two of our feathered inhabitants, the Cuckoos, in addition to the power of migrating annually from the Tropics, possess the extraordinary faculty, or instinct, of imposing their eggs upon other birds; and coolly, from malice aforethought, leaving them to the tender mercies of the strangers. Why this neglect of parental responsibilities, why this leaving to others of duties strictly belonging to themselves?

Let us consider some of the suggestions as to how the habit has become established, and endeavour to throw light upon this mystery.

Among the lower animals there are numbers of instances of commensalism, and innumerable cases of one species being parasitic within, or upon, the body of another, but nowhere, save in the great class Aves, do the parents deliberately leave the egg to the care, or possible neglect of an outsider. Of course it is known that the dog will nurse kittens, and a turkey hatch out a brood of chickens, etc., but these are mere accidents, or due to artificial interference - that a snake will leave her eggs in the melon patch to be hatched by the heat of the sun - that the Ostrich or the Australian Brush

Turkey will act similarly - but actual deliberate boarding out of ones offspring, or of an egg that will produce such offspring - a peculiarity of certain birds - so far as I am aware does not exist among the higher or lower orders of animal life.

Newton says "the reflective naturalist will pause to ask how such a state of things came about, and there is not much to satisfy his inquiry."

"Certain it is that some birds, whether by mistake or stupidity, do not infrequently lay their eggs in the nests of others. It is within the knowledge of many that Pheasants' eggs and Partridges' eggs are often laid in the same nest, and it is within the knowledge of the writer that Gulls' eggs have been found in the nests of Eider Ducks, and vice versa; that a Redstart and a Pied Flycatcher will lay their eggs in the same convenient hole, the forest being rather deficient in such accommodation; that an Owl and a Duck will resort to the same nest box, set up by a scheming woodsman for his own advantage; and that the Starling which constantly dispossesses the Green Woodpecker, sometimes discovers that the rightful heir to the domicile has to be brought up by the intruding tenant. In all such cases it is not possible to say which species is so constituted to obtain the mastery, but it is not difficult to conceive, that in the course of ages, that which was driven from its home might thrive, through the fostering of its young by the invader, and thus

the abandonment of domestic habits and duties might become a direct gain to the evicted householder. This much granted, all the rest will follow easily, but it must be confessed that this is only a presumption, though a presumption that seems plausible, if not likely." (1).

Darwin says, "It is supposed by some naturalists that the more immediate cause of the instinct of the Cuckoo is, that she lays her eggs not daily, but at intervals of two or three days, so that if she were to make her own nest, and sit on her own eggs, those first laid would have to be left for some time unincubated, or there would be eggs and young birds of different ages in the same nest. If this were the case the process of laying and hatching might be inconveniently long, more especially as she migrates at a very early period, and the first-hatched young would have to be fed by the male alone. But the American Cuckoo is in this predicament, for she makes her own nest, and has eggs and young successively hatched, all at the same time. It has been both asserted and denied that the American Cuckoo occasionally lays her eggs in other birds'nests, but I have lately heard of the discovery of a young Cuckoo, together with a young Jay in the nest of the Blue Jay, and as both were nearly feathered, there could be no mistake in their identification. I would also give several instances of various birds which have been known occasionally to lay their eggs in the nests of

other birds. Now, let us suppose that the ancient progenitor of our European Cuckoo had the habits of the American Cuckoo and that she occasionally laid her egg in another bird's nest. If the old bird profited by this occasional habit, through being enabled to migrate earlier, or any other cause, or if the young were made more vigorous by advantage being taken of the mistaken instinct of another species, than when reared by their own mother, encumbered as she could hardly fail to be, by having eggs and young of different ages at the same time, then the old birds or the fostered young thus reared, would gain an advantage. Analogy would lead us to believe that the young thus reared would be apt to follow by inheritance the occasional and aberrant habit of their mother, and in their turn would be apt to lay their eggs in other birds' nests, and thus be more successful in rearing their young. By a continued process of this nature, I believe" says Darwin, "that the strange instinct of our Cuckoo has been generated. It is undoubted that though very rare, reversion to the long-lost habit of nidification has occasionally been recorded." (2).

Jerdon says that parasitism in Cuckoos arises from a lack of sufficient intelligence to build a nest, and that this low intelligence is evidenced by the weak sexual organs, and the eggs, which are very small in comparison with the eggs of other birds. (3).

We know that a reduction in the size of the egg is not

necessarily a proof of weak sexual development, but often as much an evidence of protective resemblance as is the colouring and spotting of the surface of the egg. It is notorious that all the world over, the parasitic Cuckoo lays an egg absurdly small for the size of the bird, but nearly always deposits it in the nest of a bird which lays eggs smaller than its own. In this way it is easy to see that those Cuckoos would be preserved (whose eggs most approximated in size, as in colouring, to those of the rightful owner of the nest; while those less fortunate in this respect would become extinct, by the builders throwing out, or deserting the strange-looking eggs. It is probable that this choice of nests containing very small eggs, makes it more easy for the young Cuckoo to perform its villainous work of ejection, which would be difficult, if not impossible, with birds hatched from eggs of a larger size.

It is curious that in the New World, where some of the Cuckoos have not yet acquired the habit of parasitism, but are still industrious enough to build nests for themselves, we should find Crotophaga ani, a bird which seems to form the link between the parasitic and non-parasitic Cuckoos. In this case several females unite to lay in one nest. Full details of their economy are wanting, but incubation is carried on socially, for anyone approaching the nest will disturb half a dozen of its sable proprietors, who with loud cries

seek safety in the nearest available covert. (4).
It certainly seems to me that this bird, which is a true Cuckoo in structure and migratory habits, forms a link in the chain of evidence. The nest in which these birds lay their eggs must be a very large one to accommodate a number of birds sitting side by side, or else one, or more, of the owners do the hatching for the rest. The incubation may be attended to in turn,or so to speak in 'watches' and some of the birds,being extra lazy or cunning, may scamp their duty, or be driven away, and in this way the habit of intrusting the hatching to other birds be established.
Is this loss of interest in preparing habitation for the young, and the gradual acquisition of parasitism, not connected in some way with the migratory instinct, as suggested by many people as far back as the days of Edward Jenner. It is remarkable that with few exceptions all parasitic birds are migratory, and it has always appeared to me that there must be some unexplained link between the two wonderful habits. Against this theory, however, is the fact that there are a number of birds which migrate for breeding purposes, but are not parasitic, and there are some of the parasitic Indian Cuckoos which are not considered migratory; and these facts certainly make the subject the more difficult of explanation.
The only birds other than Cuckoos which are parasitic are the Molothrus species or Cowbirds, and Cassidix

oryzivora or Rice-birds of the New World, which are all allied to the Blackbirds and Orioles, belonging to the Icteridæ. The Molothrus is migratory, some coming from southern Mexico, and spreading up through the United States to South Canada, their range extending over several thousand miles. The different species exhibit almost every gradation between true nest-building and parasitism, and like the Crotophaga they are polyandrous, and breed promiscuously. (5).

Cassidix oryzivora, which has recently been found to be parasitic by Dr Goeldi of Para, belongs to a different genus, but to the same family of Icteridæ. I can obtain no details of its economy beyond the fact that this bird deposits its eggs consistently in the hanging nests of the different species of Cassicus. It has an extensive range from Northern to Southern Brazil, is partially graminivorous, and chooses as its hosts birds of about the same size as itself, Cassicus persicus, Ostinops decumanus, and Ostinops cristatus, all of which species are gregarious and build in colonies, often hanging their purse-like nests in beautiful symmetrical rows, from the tips of the fronds of the Cabbage-palm. Cassidix belongs to the sub-family of Quiscalinæ or Grackles, many of which are gregarious, it is a near relative of Molothrus, and we shall await with great interest details of its economy, in order to clear up this question of mixed breeding or polyandry. (6). It is remarkable that the very birds upon

whom Cassidix foists its eggs, are themselves generally seen in small flocks of seven or eight males; and the males, according to Mr Goodfellow, always seem to outnumber the females. (7). These birds are near relatives of the parasite, and one species Cassicus persicus was observed, by the same writer, occasionally to have young of various ages in the nest, a point to which I shall refer later. It is quite possible that we shall yet hear of parasitism in several of the Cassicus species (8). There is another family of parasitic birds, the African Indicatoridæ or Honey Guides,which for many years were classed as a sub-family of the Cuculidæ, but have now been placed near the Barbets and Woodpeckers. They are zygodactylous, insectivorous; often feeding on bees; are extremely fond of honey, which they expect man to obtain for them, for it is undoubted that they will lead him to the locality of the bee-nest for that purpose. So far as I can gather of most of the species the bird is nearly always seen alone, I can get no details of its pairing, but the various species are known to deposit their eggs in the nests of other birds, among which are Hirundo,Dicrurus, and Melanobucco Torquatus the South African Barbet.Some of the Indicator species are bee-eaters, others refrain from touching these insects, but eat honey; some at times build pensile nests, in which they deposit their pure-white eggs; but the members of the Family are as a rule considered to be pretty generally parasitic.

Until further details of the Cassididæ and Indicatoridæ are to hand we cannot hope to throw much light on the subject of parasitism, so far as they are concerned, but our knowledge of the habits of Cuckoos and Cowbirds is such, as to warrant our coming to a fair conclusion on the subject, without any great stretch of imagination. From what we find of the American Cuckoos, the suggestion put forward by Darwin appears to be the most reasonable step towards an explanation.

Bendire says, "The Yellow-billed Cuckoo is one of the poorest nest-builders known to me, and undoubtedly the slovenly manner in which it builds its nest, causes the contents of many to be accidentally destroyed,and this probably accounts to some extent for the apparent irregularities in their nesting habits. The nests are shallow frail platforms of twigs and rootlets,through which the eggs can often be seen. The number of eggs varies from two to five, but now and then as many as six or seven, but it is questionable whether they are all the product of one female. Usually an egg is laid daily, and incubation does not begin till the set is completed, but it is well known that the bird may commence incubation when the first egg is laid, and at the same time continue laying at irregular intervals, varying from two to eight days, so that one will occasionally find birds of different ages, and eggs of different stages of incubation in the same nest. It is also well known that this species will occasionally

deposit an egg or two in the nest of the Black-billed Cuckoo, and the latter returns the compliment, and now and then the egg has been found in the nests of other species, such as the Wood-thrush, Robin, Cat-bird, Black-throated Sparrow, Cardinal and Mourning Dove.The majority of these cases may well have been due to accident, its own nest having possibly been capsized, necessity compelled the bird to deposit its egg elsewhere. It is indisputable that latent traces of parasitism do exist in our Cuckoos, and especially among the Black-billed species. From personal observation I am inclined to believe that the Black-billed Cuckoo is more irregular in its nesting-habits than the Yellow-billed, and that cases of parasitism are of more frequent occurrence. I also think that their eggs are much oftener found in different stages of incubation than appears to be the case with the former species." (9).

The nests of the Yellow-Billed are slightly better built than those of the other species but nevertheless numbers of cases are known of true parasitism in this bird. The eggs have been found in nests of Wood-pewee, Warbler, Cat-bird, Sparrow, &c., and in the nest of the last-named bird the young Cuckoo when hatched proved to be the tyrant which he is elsewhere, for he quickly threw his companions out of the nest. Burroughs says, "The European Cuckoo builds no nest,but puts its eggs out to be hatched, as does the American

Cow Blackbird; and the American Cuckoo is master of only the rudiments of nest-building. No bird in the woods builds so shabby a nest; it is the merest make-shift, a loose scaffolding of twigs through which the eggs can be seen, and which is often destroyed by a rough gale." A large gooseberry-bush standing in the open field not far from his house, was occupied by cuckoos for two seasons in succession and after an interval of one year for two seasons more. This gave him an excellent chance to observe them. He says the mother-bird lays a single egg, and sits upon it a number of days before laying the second, so that he has seen one young bird nearly grown, a second just hatched and a whole egg all in the nest at once. This is the settled practice, the young leaving the nest one at a time to the number of six or eight. The young have quite the look of the young of the dove in many respects. The mother-bird is unnaturally indifferent when her nest and young are approached, she makes no sound but sits quietly on a near branch in apparent perfect unconcern. These observations together with the fact that the egg of the Cuckoo is occasionally found in the nests of other birds, raises the inquiry whether the American bird is slowly relapsing into the habit of the European specimen which always foists its egg upon other birds. Its irregular manner of laying seems better suited to a parasite like the Cow-bird or the European Cuckoo, than to a regular

nest-builder. (10).

Turning to the Cow-bird, Molothrus ater, Bendire says: "It is a well-known fact that the Cow-bird is a parasite, building no nest, but inflicting its eggs usually on smaller birds, leaving to them the labour and care of its young. It appears to be entirely devoid of conjugal affection and practises polyandry, there being generally more males than females in the small flocks in which they are found. The laying season begins about the middle of May and lasts for about two months during which time from eight to twelve eggs are laid by each female, or the equivalent of two broods, and several days elapse between the laying of the eggs. It is likely, and this is fortunate, that not more than half of those are hatched,as some are occasionally dropped in old or abandoned nests, or, when the female is hard pressed, even on the ground. When she wishes to deposit her egg, the female leaves her associates, and begins her search for a suitable nest; usually selecting one of a smaller species than herself; she does not forcibly drive the owner from her nest, but waits for an opportunity to drop her egg in it when it is unguarded. She imposes upon nearly a hundred different kinds of birds including even the Yellow-billed Cuckoo herself. The young bird grows very quickly and seizing all food which comes to the nest, starves its companions in about three or four days." (11). It is asserted that Cowbirds

occasionally build their own nests, but Bendire discredits the statement himself. From what we know of the Cuckoo this is quite possible.

Another observer, Mr Hudson, tells us that Molothrus badius sometimes lives promiscuously together in flocks and sometimes pairs; it either builds a nest of its own, or seizes one belonging to another bird, throwing out the nestlings; it either lays in this nest, or builds one for itself on top of it; it usually hatches and rears its own young, but is often parasitic. Another species, Molothrus bonariensis, is more highly developed, and is well on the road to parasitism, though occasionally it tries hard to return to the architectural habits of its ancestors. This bird, so far as is known, invariably lays in the nest of strangers, but it is remarkable that several sometimes commence to build an irregular untidy nest of their own, placed in ridiculous situations, such as on the leaves of a large thistle, and Mr Hudson observes they never complete or use their nest. They lay from fifteen to twenty eggs in a large foster-nest, peck or make holes in the other eggs in the nest, and often drop their eggs on the ground. The third species Molothrus ater or pecoris I have already alluded to. It has acquired the full habit of parasitism, and never lays more than one egg in a foster-nest, so that its young is securely reared. (12).

The habit of parasitism then, seems to be found chiefly in birds which have this peculiar irregularity of laying, but the cause of this irregularity is hard to determine. It is not the least curious part of the whole business that of all these American birds, including nearly a dozen species of Cuckoos, and five or six species of Cowbirds, a large majority of them have the regular or occasional habits of consorting in parties, breeding promiscuously, laying in common nests, and practising polyandry, and if there is any evidence of the same habits pertaining elsewhere, we should be nearer a solution of the origin of parasitism. What is the cause of this irregular ovipositing, it is as yet hard to say, but that it almost universally obtains among parasites we have already seen.

Is it not possible that the Spring migration of the Cuckoos and Cowbirds which, as is well known, always results in the males arriving first, (31) may have helped to produce this promiscuous pairing, and polyandry? Has this promiscuous pairing and shortage of females not led to breeding and nesting in parties, to laying eggs in 'common' nests, and to irregular laying, and hatching of eggs of various ages? Having acquired the instinct of getting some of its eggs hatched in a common nest, along with those of others of its own species, is there not a likelihood that to still further lessen the discomfort of a long incubation, and a tedious tending of a family, and to be

earlier ready for the return migration, the female Cuckoo should deliberately set to work and impose her eggs upon a suffering public? To lay six eggs, and to drop them into six different nests, would be a much better arrangement than to lay and tediously hatch,or assist to hatch the same eggs, a task that would take nearly twice as long, and might prevent the female from being ready for her migratory flight. The young birds after being tended by their foster-parents can follow later, as we know they do, and the female bird is free to lead a roving life, with none of the cares of motherhood; she can continue to lay eggs right on; or, what is more likely after an interval of a week or two, can start off with a new set of mates, and lay another batch of eggs, which will be similarly boarded out at the expense of others.

As bearing on this question of nesting in common, it is interesting to notice that in all of these parasites, probably the first step is the deposition of the egg of any one species in the nest of its own immediate relatives, of the same species; then of birds of similar habits as to breeding and nest-building, near relatives; then more distant relatives; and eventually birds of almost any genus, family, or order. The American Cuckoos frequently impose upon other Cuckoos of the same or of different species; similarly Cowbirds upon other Molothrus individuals - one species consistently upon another Molothrus which builds a

nest; all of the Molothri upon Blackbirds and Orioles their immediate 'first cousins'. Cassidix oryzivora which sometimes builds a purse-like nest, utilises the pensile dwelling of its Cassidine connections, and the Indicator or Honey Guide often drops her egg into the home of her cousin the Barbet.

It has been suggested that the irregular laying might be the result of the parasitic habit, acquired by the female through the necessity of having to retain the egg until a suitable nest is found in which to deposit it. This theory can however be put on one side by what we know of the American Cuckoos, where we find irregular egg-laying by Cuckoos, which are not yet fully parasitic, proving conclusively that this pecularity of ovipositing precedes parasitism; besides which it is not uncommon in other birds.

May not this pecularity have been acquired, for the very purpose of having birds of various ages in the nest, so that each succeeding egg may get the advantage of the warmth of the body of the previously hatched chicks, while the mother is away foraging on behalf of her offspring? As the male Cuckoo is notorious for the lack of interest which he takes in the nest or its contents, and does not know the joys of domestic happiness, the young birds have to act the 'big brother' to each arriving infant. The same thing according to Mr Bosworth Smith is seen in the Barn-owl, he says - "Alone I believe among birds, she sometimes

lays her eggs not continuously, but at considerable intervals of time. At first, it may be, she lays two eggs, on which she will sit for a week or two, then two more, and then when she has hatched the first two, perhaps three more, so that you may find fresh eggs, hard-set eggs, and young birds in the same nest. What is the reason for this peculiarity? Is it that by leaving the later eggs to be hatched in part at least by the warmth of the young birds, she has more leisure by an all-night absence to satisfy the cravings of her voracious brood? (12). The male Owl, though remaining faithful to his mate, does not assist in the hatching of the eggs, and the female with so large a number as six or seven chicks to feed, has acquired the advantageous method of keeping her eggs warm in her absence. She not only approaches the Cuckoo in this extraordinary peculiarity, but her nesting-habits are of the most primitive description. No Owl has much building-talent, she may lay her eggs, five or seven in number in an old Squirrel's drey far out on the bough, sometimes in an old Hawk's or Crow's or Magpie's nest, not caring to do anything to repair, or make them comfortable (13). The Owl is sometimes sociable enough to lay her eggs in the same dovecote with Pigeons, and from the moment that Waterton was able to exclude rats from his dovecote, there was no further massacre of young Pigeons, and thenceforward both Barn-owls and Pigeons lived, and laid their eggs and hatched and

reared their young, as members of one happy family. Pigeons do not mob the Barn-owl, who lives amongst them, because they know him well; other birds do mob him, because being a bird of night, and quite unlike themselves, they hardly know him at all." (14). Pigeons have the peculiar habit of laying pairs of eggs at intervals, and of having eggs, small chicks, and fairly large ones in, or about, the nest at the same time. This, no doubt, is partly for the same reason of supplying vicarious warmth, while the parents are on the search for food, but also in order to further the production of as many chicks as possible in the one season. The New Zealand Hawk,Circus Gouldi, has the habit also, on occasion, of depositing its eggs at intervals, and here again the same reason comes into play. Hawks have much hunting, soaring,and searching, away from the nest, before they can get food for their hungry little ones, and this irregular laying no doubt enables the uncovered eggs and young to withstand the effects of the frequently inclement weather. Cuckoos, Cowbirds, Pigeons, and Hawks are all most voracious feeders, and the efforts of both parents and foster-parents are necessary in order to provide sustenance, and satisfy their clamorous offspring. Pigeons, Owls, and Hawks strictly pair, and are strictly faithful to their respective mates, and flimsy and rude as the nests of all of them are, it is undoubted that both sexes take their share in the 'burden and

heat of the day'. Cuckoos do not pair, and parasitism consequently results.

There is another possible reason for the irregular laying of eggs. Young Cuckoos and Cowbirds are so voracious, and their natural insect food so unsatisfying, that in those cases in which the parasitic egg is hatched, the intruder finds it expedient either to throw out, or by seizing all food, to starve to death in a few days, the rightful tenants of the nest. May not the mother Cowbird or Cuckoo through countless ages have witnessed such a struggle in her own rude nest; and unconsciously finding one youngster alone of a large brood, and that the strongest or oldest to survive, have gradually come to lay her eggs at intervals, so that at no time would food for a bird at one age, be exactly suitable in quantity or quality, for a bird at an older or younger age? Soft Grubs and other minute insects for the tiniest chick; Moths and Butterflies for the next in size; Caterpillars and other hairy insects for still larger; Beetles and hard-backed Cockchafers and Crickets for the next; and finally Lizards and even small Frogs, for those about to quit the nest. Does it not seem likely that an advantage would be gained by that mother, which had her chicks separated by the widest intervals in ages, so that, having satisifed with some trouble the greedy eldest, she could with more leisure attend to the next in size; and finally with little trouble, the tiny demands of

the infant? In addition to this, the half-fledged bird is not so likely to hustle, and throw out a tiny nestling, which hardly interferes in any way with its feeding-arrangements; so that this fact also must be taken into consideration.

It is undoubted that the 'heaving-out' process takes place before the young parasite is three days old, it having the instinct to practise this barbarity upon any occupant of the nest which it finds it can wriggle under and eject. Is it not significant that the young American Yellow-billed Cuckoo, which will amicably accept its due proportion of food in a nest containing older and younger brothers and sisters, on being hatched in a nest alongside of birds of its own age, will immediately hustle them from the nest? (15). In his own true domicile, if the eldest bird, he will probably have the nest entirely to himself for a week, and then he may find beside him a smooth round egg, which he will have considerable difficulty in balancing on his back, and so disposing of; but as a matter of fact his hustling propensities are by this time almost got rid of, and the new object is probably left undisturbed. If the bird is himself a younger brother, he will find any attempts at hustling his elders, childishly futile; they on their part having neither the wish nor the necessity to displace him. At the same time their very presence in the nest would effectually prevent his hurling out an egg if such

were laid beside him. When two Cuckoos' eggs are deposited in the same nest, and hatched at the same time, a tremendous struggle takes place for mastery, and after alternate attempts at throwing out each other, the strongest or more adroit, at length succeeds in attaining its desire, and becoming sole tenant of the nest. In this way numbers of Cuckoos and Cowbirds are annually sacrificed to the superior strength of their foster brothers or sisters, two or more of which have been 'dumped' into the same nests by their respective parents (16).

This ovipositing at intervals does not seem to be entirely confined to ~~the~~ parasitic birds, but that it is almost universal among them, is undoubted; and by many it is looked upon as the immediate cause of parasitism.

To recapitulate: male Cuckoos and Cowbirds, are always in the majority especially at the beginning of the breeding-season, and for reasons before mentioned, this may be partially due to the long flight of migration.

Coindident with this preponderance of males, promiscuous breeding, and polyandry very generally obtain among parasitic birds.

Owing to the absence of domestic habits in the male, the female Cowbird or Cuckoo, being single-handed, has almost lost the faculty of nest-building, and is contented with a few poor sticks, through which the eggs

can be seen, and from which eggs and young are often capsized by rough weather.

Owing to an insufficiency of nourishment, at all times of a very unsatisfying nature, the stronger young Cowbirds and Cuckoos, in the struggle for existence, have acquired the habit of either appropriating all food, to the fatal detriment of the weaker; or else of hustling them over the side of their flimsy domicile.

Finding that many of her young are sacrificed, and that it is impossible for her to bring them all to maturity, if fed at the same age, the mother has acquired the habit of irregular laying. This is a protection in warmth to her eggs and chicks, during her absence from their wind-swept tenement, is a preventive against the cruel ejection of the weaker, and by reducing the need for appropriation of all food by the stronger, is a means of lessening the burden of feeding the young.

Owing to the promiscuous breeding, nesting on common nests, or laying in a common 'foster-nest' of 'boardinghouse' is frequently seen in Cowbirds and Cuckoos.

Some of the American Cuckoos show irregular laying of eggs, generally make their own nests, but occasionally practise parasitism.

The different species of American Cowbirds show irregular laying of eggs, and all the stages between nest building, laying in common nests, in common 'boardinghouses', and true parasitism.

Some of the American Cowbirds and Cuckoos, and our

own and the Old-World Cuckoos having probably passed the stages of nesting in common, and of depositing their eggs in common 'lodginghouses', but still retaining the habit of irregular ovipositing, find it expedient, in order to be ready for the return Autumn migration, to drop their eggs one by one into the nests of other birds.

The whole matter may be placed in a nutshell: Owing to the promiscuous breeding, entire neglect of domestic habits, and provision by the male of a home for his doubtful progeny, the unfortunate female, tired of having single-handed to provide both dwellinghouse and sustenance, leaves one the doorsteps of those whom she thinks most likely to take pity on, feed, and bring to maturity, her fatherless children.

I have shown that the loss of domesticity in the male is the probable cause of parasitism, and I will now mention an instance which seems to indicate that a return to decent behaviour in this respect, is very soon followed by a resumption of the habit of nest-building. The true Indian Cuckoos are strictly parasitic, and Hierococcyx sparviroides is considered by most observers to be universally so. The Indian Cuckoos are seldom seen in pairs, generally singly, or in small parties, but this particular species is said by Allan Hume to be more often seen in pairs than any of the other ones. That this is an evidence of a leaning towards domesticity, we find in the interesting fact that Mr R.H.Morgan

of the Madras Forestry Department avers that on one occasion he watched this species actually build its own nest, and that he then removed the eggs of which four were laid (17).

It is of great interest that we find in other parts of the world besides America accounts of parasitic birds consorting in parties or flocks, and the same promiscuous breeding and polyandry, as a stepping-stone to true parasitism. Jerdon says that the true Indian Cuckoos do not pair, many males being seen with one female, and mentions this particularly of Coccystes melanoleucus, and he says of the Indian Koel (Eudynamis orientalis), that though not generally gregarious, several may often be seen on the same tree (3). Dr. Brehm says of the European Cuckoo (Cuculus canorus), that the relationship between the two sexes seems to be peculiar. During pairing-time the male bird acts like a headstrong passionate idiot. How angry is its cry and what a rage it gets into when another of the same species dares to invade its territory! It is possible that the Cuckoo is content with one mate, yet it is more likely that neither sex is particular in the matter. It seems much more likely that each male should court all hen birds alike and vice versa, else why this unbounded jealousy (18). Mr Percival reported of Chalcites smaragdineus in South Africa that he had seen it in flocks, and found it pugnacious, six or eight males chasing each other, with only one female (19).

Out of 25 specimens of various species of Cuckoos obtained in East Africa by Mr F. Jackson, only four were females, and one of these was immature (19). The experience of many other explorers points to the same numerical preponderance of male Cuckoos over the females in different parts of the world (19). Of the Australian birds Mr Campbell writes,-"While in a forest near Cape Leewin in October 1891, I saw four or five Bronze Cuckoos in shining coats making a great stir in a low tree, chasing each other and making melancholy tremulous whistling noises. Anxious to ascertain the cause of the disturbance I approached too close to the little company, which immediately departed to another tree" (20). Mr Broadbent reports,"I have seen in January flocks of Channel-bill Cuckoos in company with Streperas just under the mountains in the Big Scrubs" (21). Gould says of the Pallid Cuckoo, "During the vernal season it is an animated and querulous bird,and may then be seen either singly or two or more males engaged in chasing each other from tree to tree" (22). Mr Robinson says of the North Queensland Scythrops novæ-hollandiae,- "plentiful, feeding in flocks on very high trees" (23). Latham says of the Channel-bill,- "It is chiefly seen in the morning or evening, sometimes in small parties of seven or eight, but more often in pairs." Turning now to the New Zealand birds, I am informed on good authority that the Bronze Cuckoo migrating from Australia to the West Coast is seen in

large numbers at Totara and old Maori battle field, two miles south of Shortland, Thames (24). The Long-tailed Cuckoo is plentiful on both sides of McKinnon Saddle, and the Shining Cuckoo is seen occasionally in little flocks. (25). Captain Mair says, "While passing down the Hurukaureo River during the intensely hot weather of February 1872, I was astonished at the number of Long Tailed Cuckoos that coursed overhead. During the three days that we were making the passage, we saw some hundreds of them, swarming about in the air like large Dragon-Flies, as many as twenty or thirty of them being sometimes associated together. The loud clamour of their notes became at length oppressive. There was much dead timber on the banks of the river and it appeared to me that the birds were feasting on the large brown Cicada. This is the only occasion on which I have observed this species consorting together as it were in parties." (26). Mr Bell of the Kermadec Islands says, "I have never seen them pairing or flying in pairs, they mostly occur singly, but sometimes in small flocks of four up to seven or eight." ~~6/5/04~~. (27). A correspondent at the Bay of Plenty tells me that he has seen as many as three in one tree apparently busy after Sparrows'nests, another in the same locality that he saw a dozen in some trees near the post-office on one occasion (28). Mr Gallien, of Winton, saw a Long-tailed Cuckoo fly on to a tree and scream at intervals attracting as many as four more, that is five on one tree at one time (29).

Mr McLay saw four of the same birds in a small gully at Waikouaiti one morning, they were being fiercely attacked by Tuis (30). Mr Elsdon Best's Maori informant says,- "We do not recognise male or female, we do not know that they pair," and as before mentioned he saw five or six one day all flying together (31). Mr Crawford Anderson says,-"I do not think our big Cuckoo pairs, as I have seen two males following one female, and she was evidently quite unconcerned which of them gave her attention" (32).

Numbers of correspondents say that they have never seen a pair of New Zealand Cuckoos together, that it is a solitary bird, and they entirely discredit the statement that it breeds in New Zealand; and I may say that during my own observations of the Cuckoo extending over a period of twenty-five years, I have never seen more than one bird at a time. Their courtship is evidently of the briefest duration, as is the case in other parts of the world. One gentleman tells me,- "When selecting a mate it is rather interesting to listen to them and to watch their movements. The male bird utters a peculiar whistle which the female answers at a considerable distance off. They gradually approach one another and take up positions about a chain apart, and there for a space of about ten minutes utter peculiar calls which they do not give on any other occasions. The female flutters her wings and seems to do her best to attract the male

bird" . Mr McLean of Te Tua says,- "One day while sitting under a Bokaka tree I noticed a peculiar fluttering in the tops of the branches and looking up saw ~~say~~ what I took to be a new bird. It was a large bird, brown in colour, and every feather seemed to standing on end, the tail and wing feathers were all spread out fan-shape, making a complete semicircle. The bird was evidently feeding and fluttered about from twig to twig, sometimes above the branches, sometimes hanging back downwards beneath the branches, and never a moment at rest, but whether feeding on leaves, berries, or insects I could not discover. I watched it for some time, and when it flew away, to my surprise I found it was just a common Cuckoo. It was about New Year time (33). This was more than likely a female bird, and it is probable that the male bird was in the immediate neighbourhood. There is no doubt in my mind that the ventriloquistic character of the call in both New Zealand Cuckoos, has to do with the promiscuity of their relationship, and is probably utilised by the male for the purpose of calling the female, while attempting to deceive the other males as to his whereabouts. It is most interesting to find that in other countries the same ventriloqial character is observed of the call of many of the Cuckoos, for instance, the Plaintive Cuckoo of India (Polyphasia nigra) has a peculiar call of two syllables, to which the bird by pointing his head

in different directions, as he sits calling, gives a most ventriloquistic effect, sometimes appearing as if coming from one side, and immediately afterwards from the opposite (17). The same thing is known of the African and American birds.

Further careful observation of the habits of the two New Zealand Cuckoos is necessary to clear up the question, but it seems to me undoubted that like Cuckoos elsewhere, they will be found to be polyandrous; there is no pairing in the true sense of the word, though it is undoubted that the assistance of both male and female is necessary in the construction of a nest. Wallace tells us that the male bird of a pair, often a young one, may learn from his mate, who has had previous experience of nest-building, and, vice versa, a young female is often helped by an old male bird and a very neat nest constructed. On the other hand, a pair of young birds new to the business often construct a very poor habitation indeed. The female Cuckoo or Cowbird, whose companions roam about the bush, has no mate to help her, her feet and bill are ill-adapted for nest-construction, so she is either content with a few poor sticks on which she lays her eggs or else she drops them one by one into the nests of other birds (34)

It will be seen that we have got one step further into the heart of the mystery. We have found that all parasitic birds are polyandrous, that is, there is no pairing - but we must go a great deal further yet, and find

if possible what has led to this lack of pairing - to what is due this preponderance of males, and whether the whole thing is not really after all ~~not~~ an indirect result of the migrating habit.

BIBLIOGRAPHY AND REFERENCES.

1. Encycl.Britann,9th Edit. Vol.III. page 772.
2. Origin of Species,Darwin 6th Edit.Chap.8 page 215.
3. Birds of India, Jerdon, Volume I. page 321.
4. Dictionary of Birds, Newton, part I page 126.
5. Origin of Species,Darwin,6th Edit.Chap.8 page 215.
6. Proc.Zool.Soc. Jan. 5th 1892
7. Ibis Volume for 1900 page 640.
8. Ibis Volume for 1897 page 363.
9. Life Histories of N.American Birds,Bendire,page 21.
10. Locusts and Wild Honey, Burroughs, page 60.
11. Life Histories of N.American Birds,Bendire,pages 437 & 442
12. Nineteenth Century, Nov.1902 page 758.
13. ibid. page 764.
14. ibid. page 766.
15. Life Histories of N.American Birds,Bendire,page 442.
16. History of British Birds,Bewick,Volume I. page 270.
17. Birds of India, Allan Hume, Vol. I page 135.
18. Bird Life, Brehm, page 156.
19. Ibis Volume for 1902. page 587
20. Nests and Eggs of Australian Birds,Campbell, Vol.II. page 584.
21. ibid. page 589.
22. Birds of Australia, Gould, Vol. I page 629.
23. Ibis Volume for 1900 page 640.
24. Letter from Miss N.Sinclair,Thames,dated 27 July 1903.
25. Overland to Milford Sound,Fenwick, 1903 page 33.

Bibliography & References (Contd.)

26.History of the Birds of N.Z.,Buller,Vol.I. page 131.

27.Letter from Mr T.Bell of Kermadec Islands 6 May 1904.

28.Letter from Mr C.Thomson,Opotiki, 2nd Oct. 1903.

29.Letter from Mr L.Gallien,Winton, 8th Oct. 1903.

30.Letter from Mr Chas. McLay,Waikouaiti,10th Oct.1903.

31.Letter from Mr Elsdon Best,Ruatahuna, 8th Oct. 1903.

32.Letter from Mr Crawford Anderson,Riverton,9 Oct.1903.

33.Letter from Mr Jas.McLean, Orepuke,26th Nov. 1903.

34.Trans.N.Z.Inst. Volume 36 page 115.

35. ibid. page 137.